LECTURE NOTES

ON

LAND SURVEY –I

PREPARED BY

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Basic concept

Defn :-

Art and science of expressing the relative positions of objects lying just above, just below or on the surface of the earth.

Reference position

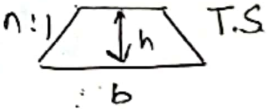
Basic measurements :-

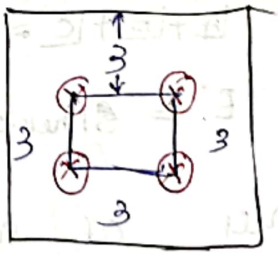
1) Horizontal Dist (Chain surveying)
2) " Angle (Compass surveying)
3) Vertical Distance (Levelling)
4) " angle (Theodolite)

Relative positions

Objectives :-

1) To prepare maps and plan.
2) To calculate areas and volume.
3) To set-out. (putting the plan on ground)





History :-

PWD - Public works Department

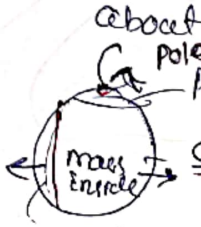
Odometer - 1st instrument of surveying

↓

distance measure.

Groma

Earth :-



Φ polar dia = 12713.8 km (12713.16 km)

Φ equ dia = Φ Polar + 42.95 km. (43.43). $\Delta\Phi = 0.34\%$ Dia of earth

Φ equ > Φ polar

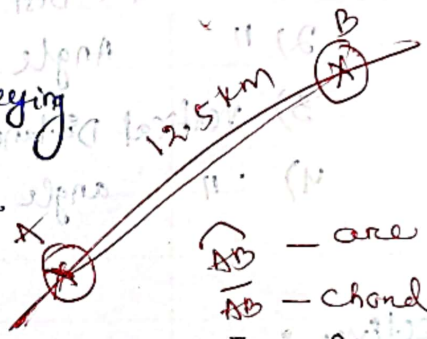
Radious of earth = 6370 km

varying diameter.

* Due to various radious the earth is assumed as sphere or cons

Primary Divisions :-

- Plane survey → not considering curvature.
  - Distance < 12.5 km
  - Areas < 195 km²
- Geodetic surveying → more accurate



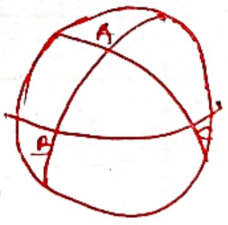
$\overset{\frown}{AB}$ – arc
$\overline{AB}$ – chord
1 cm & very very less, so we should neglate.

$\overset{\frown}{AB} = \overline{AB}$

$\angle A + \angle B + \angle C = \Delta = 180°$ → Plane

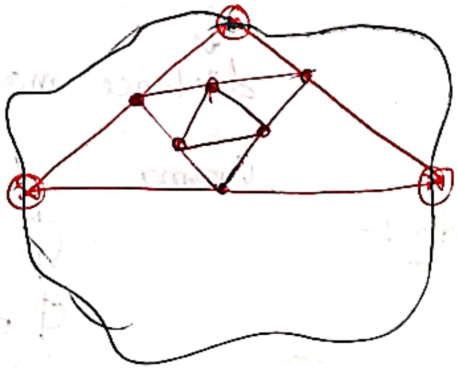
$\angle A + \angle B + \angle C = 180° + E°$ → Spherical

E = Spherical excess



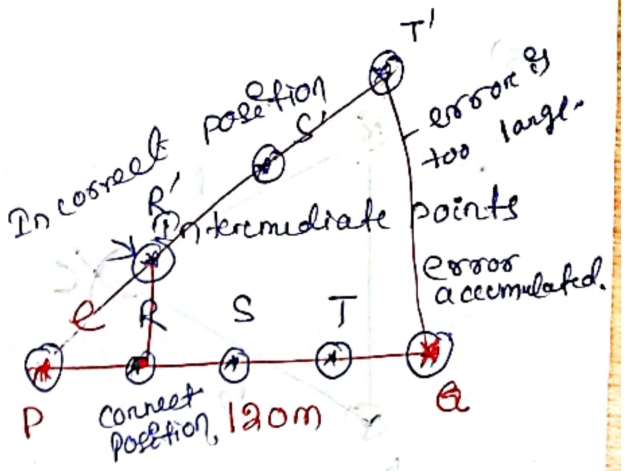
Principles of surveying :-

1. To work from whole to part.



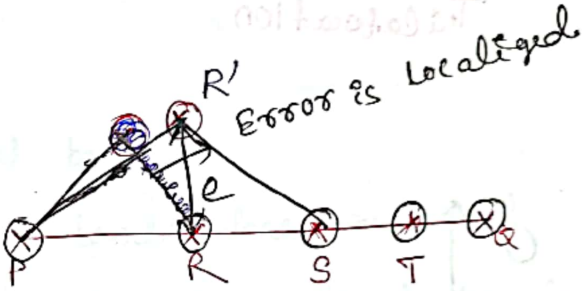
Chain 30m

Part → Whole.



PQ = PR'S'T'Q

Whole → Part



PQ = PR'STQ

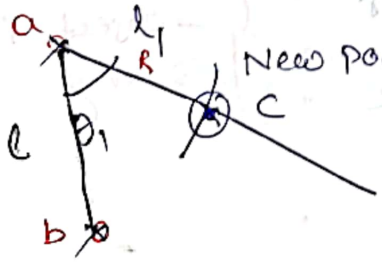
Working from whole to part:

Prevents the accumulation of the errors as they get localized.

⑤ 2nd Principle :-

Location of a new point should be worked measurements from at least 2 well defined points.

1)

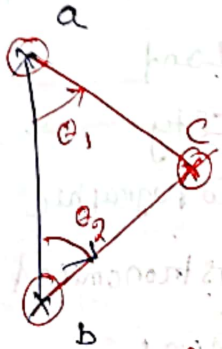


C (l_1, θ_1)

Co-ordinate of C

Polar co-ord^n

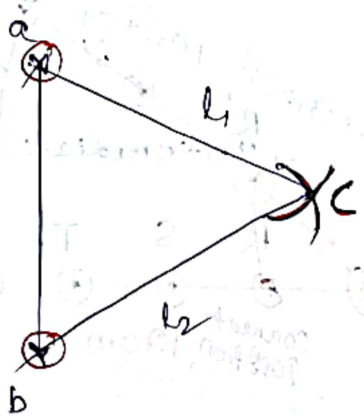
2)



C (θ_1, θ_2)

Triangulation

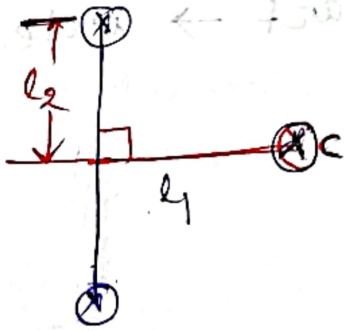
3)



C(l_1, l_2)

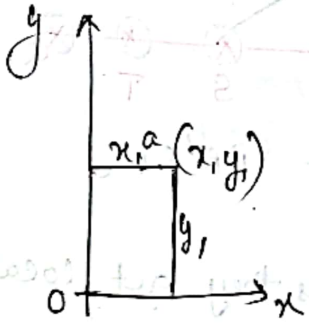
Trilateration

4)



C(l_1, l_2) { $l_1 \perp l_2$ }

Rectangular co-ordinate



Classification of Survey :-

(a) Based on purpose :-

1. Control Survey
2. Land "
3. City "
4. Topographic "
5. Astronomical "

Based on Nature of filed

6. Mine "
7. Geological "
8. Engg. "
9. Construction "
10. Military "

11. Archeology "
12. Route "
13. Satellite "

— Object of Survey

14. Cadastral "
15. General purpose "

1) Control survey :-

- They are geodetic survey conducted to establish a networks of control points.
- Control points are well defined points wrt which relative measurements are taken.
- Latitude, Longitude, Elevation wrt MSL (Mean sea level).

2) Land survey :-

- Conducted to establish legal boundaries.
- Calculate areas of agriculture lands, forest covers etc.
- Cadastral survey — cadastal map shows legal boundaries.

3) City survey :- → only for the purpose of urban planning.

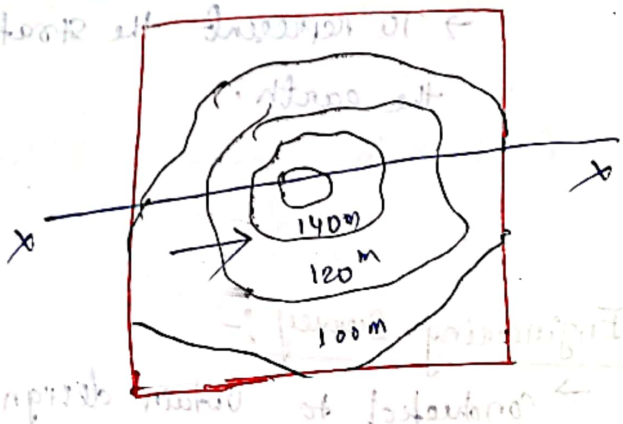
4) Topographic :-

→ General ground features of a particular region.

- Topographic survey :-

→ to identify the ground features.

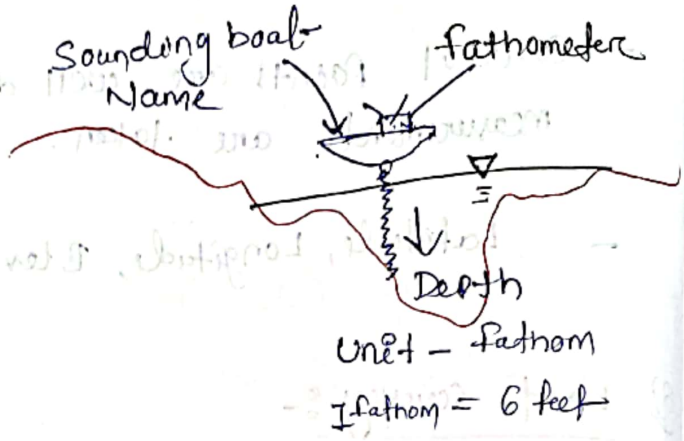
Ex :- Hills, Ridges, valley.



Ex — Contour Map

5) Hydrographic Survey :-

Conducted on and around the coastal bodies.



Unit – fathom

1 fathom = 6 feet

6) Astronomical survey :-

→ Surveys on measurements w.r.t heavenly bodies.

Stars, moon, sun.

→ Time is a measurement taken w.r.t the position of sun in the sky.

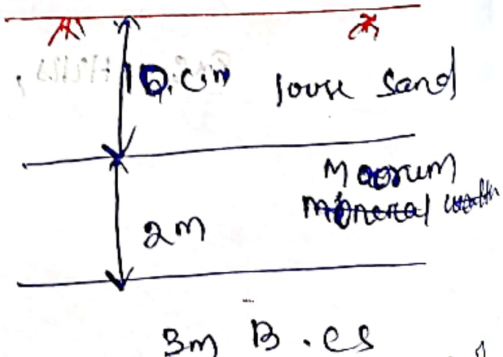
7) Mine survey :-

→ To represent the distribution of mineral wealth.

8) Geological survey :-

Subsoil investigation

→ To represent the stratification of the earth.



9) Engineering Survey :-

→ Conducted to obtain design data for civil engg. works.

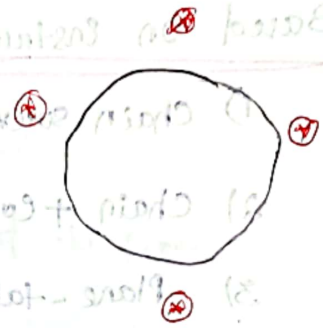
→ Ex :- Roads, railways, water supply, sewage disposal etc.

(i) Reconnaissance (Recn) :-

→ Site visit on the actual area to be surveyed.
→ Rough measurements are taken.
→ Rough estimate is prepared.
→ Identify the prominent features.

(ii) Preliminary survey :-

→ Actual precise survey on the site.
→ Accurate estimates
→ Plans.



(iii) final set-out :-

10) construction survey :-

→ Conducted after the preperation of plans.

11) Military survey :-

→ Conducted for the purpose of national security.

12) Archaeological survey :-

→ Conducted to unearth relics antiquity.

↓

Objects valuable for us but it is related to ancient or past.

13) Route survey :-

To identify the best possible allignment for a network of roads or rails.

14) Satellite survey :-

→ Conducted w.r.t satellites.
→ ISRO - IRS Satellite.

15) Gravity survey :-

$g = 9.81\ m/s^2$ → conducted to obtain 'g' value @ a place.

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General purpose survey :-

They are conducted to obtain qualitative data & quantitative data.

Ex :- Traffic volume studies.

(b)

Based on Instrument used :-

1) Chain survey
2) Chain + Compass survey → Horizontal distance, angle graphical representation.
3) Plane-table surveying
4) Levelling → ~~vertical distance~~ → vertical distance
5) Theodolite surveying. → vertical angle
6) Tacheometric survey
7) Photogrammetry
8) Total station survey (Digital)

$D = Ks + C$

Instruments for basic measurements :-

1) Horizontal Distance :- Chains, Tapes, Tacheometers, Total station, EDMI.
   - If it only used for angle = Theodolite.
2) Horizontal Angle :- Compass, Theodolite, Sextant, Total station
   - Sextant → (Navigational Purpose) → Box Sextant [Horizontal angle], Nautical Sextant [measure for stars, → astrological bodies]
3) vertical distance :- Level + staff, tacheometer, Abney level, total station (leadbent, roorky) Tree height measurement
4) vertical angle :- Theodolite, clinometer → Indian pantery, Tangential Pantery

Maps and Plans :-

→ Representation of the earth surface on a horizontal plane. (Maharashtra Public Service Commission (MPSC) exam)

Map :- Map represents a larger extend of area.
Ex:- map of a country, Geodetic surveying.

Plan :- Plan represents a shorter / smaller extend of area.
Ex:- Plan of a building, Plane surveying

→ To avoid distortions maps are projected differently compared to plans.

Scale :-

Ex:- 1 cm = 10 m
↓ ↓
In paper on Ground / unit map or plan

Def?:- The relationship between the paper distance (map or plan) to the corresponding ground distance.

Scaling :-

→ Reduce the particular ground area into something that can fit into the paper. The process is known as scaling.

Scale :-

The factor by which I do.

Ex:- 1 cm = 10 m → Distance measure

* For understanding or problem solving.
  - $1 cm^2 = 100 m^2$ → Area measure.
  - $1 cm^3 = 1000 m^3$ → Volume measure.

Types of Scale :-

1) Large scale (1 cm = upto 10 m)
2) Medium scale (1 cm = 10 - 100 m)
3) Small scale (1 cm = > 100 m) (Largest ground distance)

- Smaller the Scale larger is the ground representation & vice-versa.
- Maps → Smaller scales
  Plans → Larger scale

Sl No.	Purpose of survey	Scale	R.F
1.	Building site	1 cm = 10m	1 : 1000
2.	Town Planning reservoir Planing	1 cm = 50 cm to 100 cm	1 : 5000 to 1 : 10,000
3.	Route survey	1 cm = 10 m to 60 m	1 : 1000 to 1 : 6000.
4.	Longitudinal sect Horizontal scale Vertical scale	1 cm = 10 m 1 cm = 1 m	1 : 1000 1 : 100
5.	Topographical map	1 cm = 0.25 km to 2.5 km	1 : 25000 to 1 : 250,000
9.	Cross - section	1 cm = 1 m	1 : 100
6.	Geographical map	1 cm = 5 km to 150 km	1 : 5 00000 1 : 150 00000
7.	mine survey	1 cm = 10 m to 25 m	1 : 1000 1 : 2500
8.	Land survey / cadastral maps	1 cm = 10 m to 50 m	1 : 1000 1 : 5000
9.	forest map	1 cm = 250 m	1 : 25000

Toposheets :-

Survey of India :-

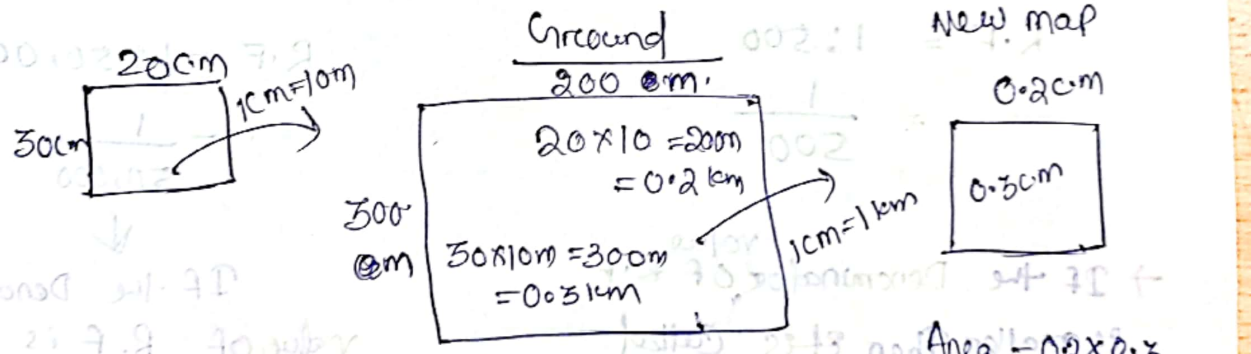
→ Divide the country into grids of 4° lat. × 4° long.

→ Sub-divide 1° × 1°.

→ Scale 1 : 25000 - 1 : 50,000.

Q) On map drawn to a scale of 1cm = 10m a piece of land was represented as 20cm × 30cm. If the map was redrawn to a new scale of 1cm = 1km, what would be the area of the land in the new map?

A)



Area = 0.2 × 0.3

A = 0.06 cm^2

Representation of scales :-

1) Engg. Scale :-

eg :- 1cm = 30m

1cm = 50m

1mm = 10m

2) Representative fraction (R.F) :-

$R.F = \frac{1}{n}$ or 1 : n

* Every unit distance in paper is same as on the ground.

Def :- The ratio of a unit map or plan distance, to the corresponding to ground distance expressed in the same unit.

Ex :- 1

1 cm = 25 m

1 cm = 25 × 100 c/m (Convert in to same unit)

1 = 2500

or

$$R.F = \frac{1}{2500}$$

Large Scale :-

1 cm = 5 m = 5 × 100 cm

R.F = 1 : 500

$$= \frac{1}{500}$$

→ If the Denominator value of R.F is smaller, then it is called as large scale.

Small scale :-

1 cm = 500 m

= 500 × 100

R.F = 1 : 50,000

$$= \frac{1}{50,000}$$

If the Denominator value of R.F is larger Then it is called as small scale.

→ Larger the denominator of the R.F, smaller is the scale of the drawing, vice versa.

Identify the smallest scale

a) 1 cm = 5 m

b) 1 cm = 500 m

c) 1/500

d) 1/5000.

2. Linear Measurement & Chain Survey

Methods of LM :-

1) Direct Distance measurement (DDM) :-

Chain, tapes etc

2) Optical distance measurement (ODM) :-

→ Distances are calculated indirectly.

→ Tacheometer, Subtense bar method

$$D.A = \frac{1}{1000} - \frac{1}{10,000}$$

3) Electronic Distance measurement (EDM) :-

→ Electro-magnetic radiations are used to calculate distances

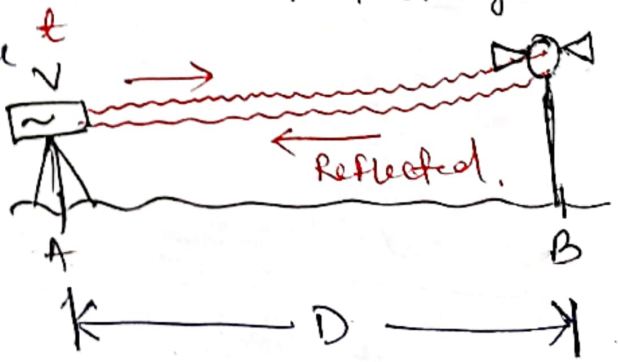
$$D.A = \frac{1}{100000}$$ for km range

v = speed of light

→ Measurement of transit time 't'

It' make the EDM costly & bulky.

→ Phase differences b/w emitted & reflected radiations are used to calculate Distances.



$$2D = vt$$

$$\boxed{D = \frac{vt}{2}}$$

Types of EDM :-

Electro-optic Instrument	Microwave emitting instruments	Infra-red using instrument
① Geodimeter	* Electrotap	– Distomat → by leica Switzerland
② Mekometer	* Distameter	
③ Rangemeter	* Decca	
	* Micro chain	
	* Tellurometer	

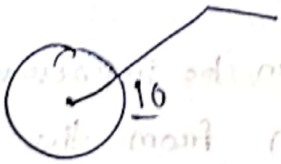
4) Approximate method :-

1) Pacing :- 1 Pace = 60 - 90 c.m Ex :- Reconnaissance work.

2) Pasometer : It counts the no. of paces.

3) Speedometer : It counts the no. of paces & multiplies with avg. pacelength. Integrated into Personal electronics.

4) Odometer / Perambulator / measuring wheel :-



P = 2 m

D = 2 × 10 = 20m

Can be used in curved surface.

5) Speedometer :-

→ on vehicles

Chain Survey:-

→ It deals with only linear measurement (Horizontal Distance). & no angular measurements are involved.

→ It is suitable for fairly levelled grounds with few simple details.

Principle of Chain Survey :- "Chain triangulation"

→ The area is divided in to a network of triangles.

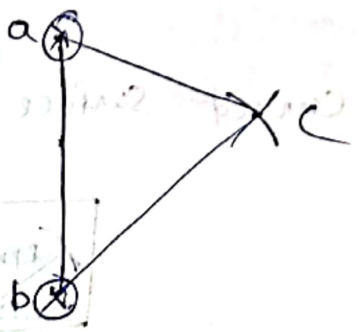
→ The triangles should be "well conditioned triangle"

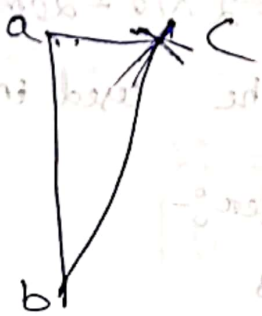
→ non of the angle of the triangle should not be to acute and non of the angles of the triangle should not be to obtuse.

→ All the angle of the triangle is $30° < \theta < 120°$.

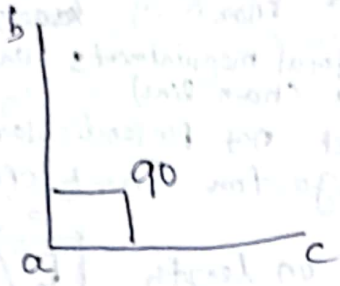
It is also known as ideal triangle.

If the 3rd vertex of a Δ can be represented by the intersection of arcs drawn from the end points of a base line, such a Δ is well conditioned Δ.

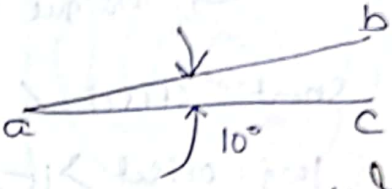




Well condition Δ



Ill condition Δ

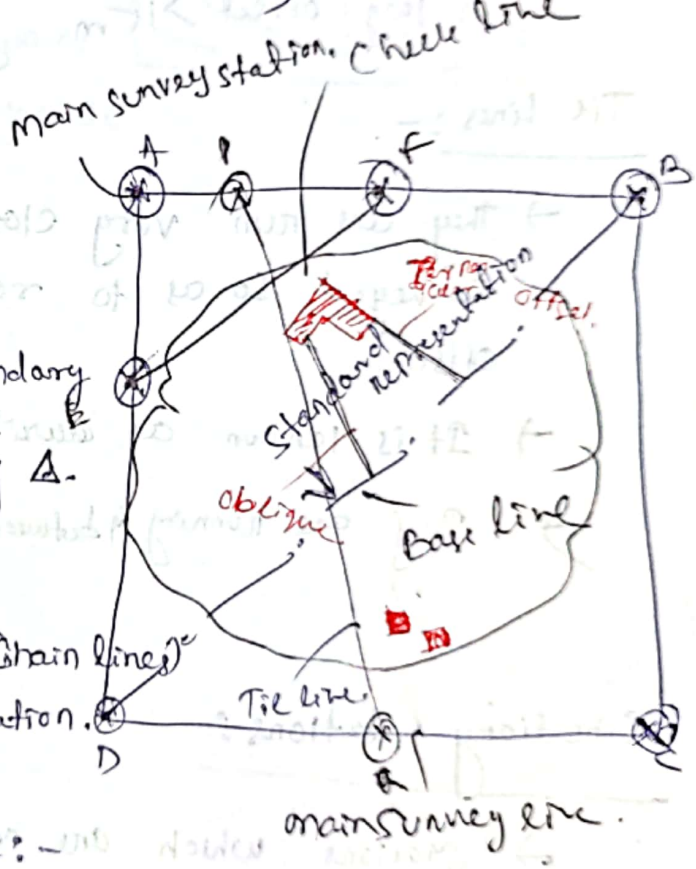


Terminology :-

1) main survey station :-

Prominent points along the boundary of the area to be surveyed.

→ These stations are denoted by Δ.



2) main survey line :-

→ They are survey lines (Chain lines) joining the main survey station.

3) Baseline / Beele bone line :-

It represent the chain passing through the centre of the area to be surveyed.

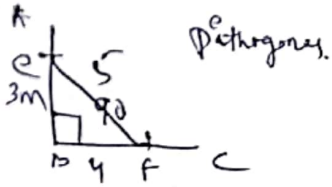
→ Longest survey line should be taken as base line.

→ Most important survey line.

4) Check line / :- Proof line :-

→ To check the accuracy of the formwork of triangles,

→ Atleast one check line / triangle should be used.



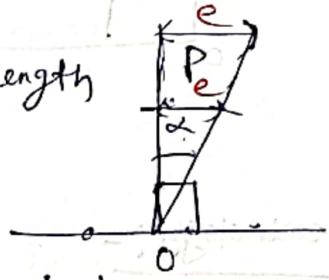
Offset :-

an object to the

They are lateral measurements taken from a chain line. is known as Offset.

→ offset ⟨ ↳ ler offset (when the lateral measurements are taken ler to the chain line)
↳ Oblique offset (Any offset not perpendicular to the chain line is known as oblique

→ Short offset < 15m
long offset > 15m
} based on length go for short offset



Tie Lines :-

→ They are run very close to the details to be surveyed so as to reduce the length of the offset.

→ It is known as auxiliary lines.

→ They are running in between subsidiary stations.

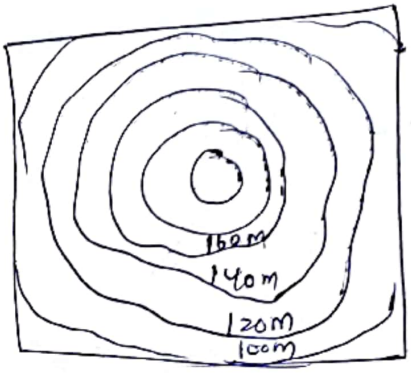
Subsidiary Stations :-

→ Stations which are on the main survey lines or any other survey lines are known as subsidiary stations.

→ These stations are denoted by ⊙ with letters S_1, S_2, S_3 ...

Contours :-

A contour line is an imaginary line joining points of equal elevation.



- Elevations of contours are expressed w.r.t MSL.
- Under water contours are known as "Sub marine contours" or Bathymetric lines."

Plane table survey

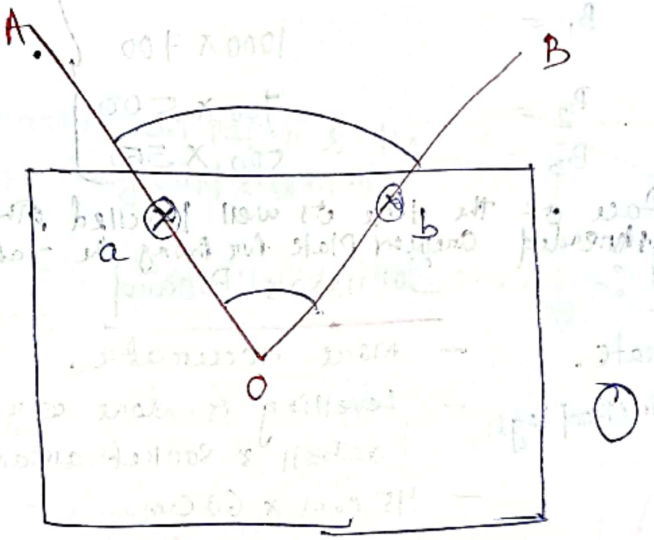
Def^{n} :-

→ It is the only graphical method of surveying that provides horizontal control points where field work and plotting are done simultaneously.

Principle :- "Parallelism".

A line drawn on the plane table will always be parallel to the corresponding line lying on the ground.

OR :- The rays drawn from stations to objects on the paper are parallel to the lines from stations to the object on ground.



OA = 20m

Oa = 20cm

1c.m = 1m.

$\angle AOB = \angle aob$

* Due to Parallelism the angles are also same.

Advantages :-

(i) Simple, Cheap & doesnot require skilled labour.

(ii) Can be used in magnetic Areas.

(iii) Area to be surveyed is in direct view.

(iv) Chances of missing measurements are less.

(v) No field book is required.

(vi) No time delay between observation & plotting.

Disadvantages :-

1) It is bulky & difficult to transport.
2) Cannot be used during rainy season & in densely forested areas. (Tropical instrument)
3) Absence of field book makes it difficult to re-plot the work to a different scale.

Instrument used :-

- 1) Board :- Should be made from well-seasoned wood like teak, Pine.
  or
  Plane table :- Protected from insect attacks.

→ Size of Plane table is drawing board 750 mm x 600 mm.

Size :- (mm x mm)

B_0 = Brill-	=	1500 x 1000
B_1 =		1000 x 700
B_2 =		700 x 500
B_3 =		500 x 350

→ The top surface of the table is well levelled, the bottom surface consist of a threaded circular plate for fixing the table.

1) Traverse Board :-
- not very accurate.
- Levelling w.r.t tripod legs.

Johnson's Board
- more accurate.
- Levelling is done w.r.t a ball & socket arrangement.
- 45 c.m x 60 c.m
- 60 c.m x 75 c.m

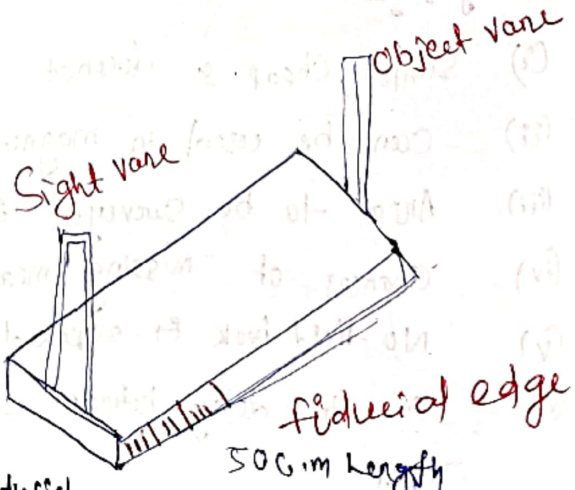
Coast survey board
- most accurate board
- Levelling is done w.r.t 3-screw levelling head.

Alidade :- * Two types of alidade.
Made up wooden or metal ruler of length 50 c.m,

→ It is used for sighting & drawing parallel lines.

:- orientation

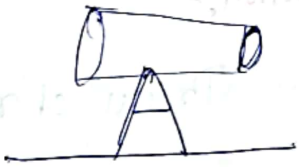
→ one edge is bevelled is known as fiducial edge.



60 c.m - 90 c.m

① Plane alidade

(2) Telescopic Alidade :-



→ for inclined ~~Sights~~ and for greater sight distance, the telescopic alidade is used.

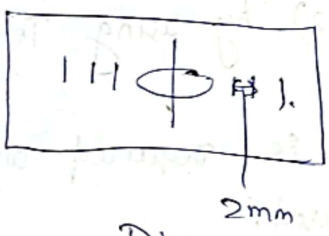
→ Sometimes tacheometric principles are also applied.

→ The alidade has no vanes. In this alidade a telescope (Stadia) is used for sighting.

Spirit level :-

used for levelling the board.

→ A small metal tube containing a small bubble of spirit.



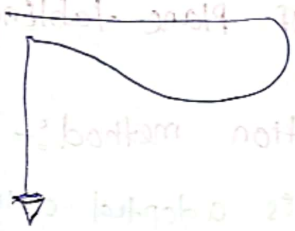
Plan

U-frame + Plumb bob :-

Centering

→ When the point marked on paper & the corresponding point on ground lies in the same vertical line.

→ U fork is a metal strip bent in the shape of U, having equal arm length.



Trough Compass :-

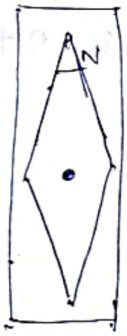
→ A rectangular box made of non-magnetic metal containing a magnetic needle at the centre.

→ To mark North direction.

→ Orientation.

Circular Box Compass :-

→ It carries a pivoted magnetic needle at the centre. The box is fitted on a square base plate.



edge bar type needle.

Temporary adjustments and orientation :-

1) Setting up → fixing the table on the tripod stand
2) Centering → Levelling the table
3) Levelling → Centring the table
4) Orientation → marking the north line
→ Orientation.

Orientation:-

Process of rotating and fixing the plane table in a definite direction so that a line on the plane table is parallel to corresponding line in the ground.

It can be done:-

1) by using Alidade or by backsighting.
2) by using Trough compass

→ It is required only when more than one instrument station is used.

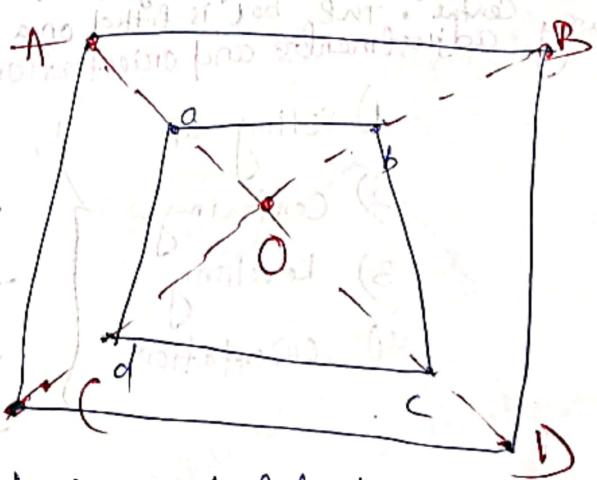
Method of Plane tabling:-

Radiation method:-

→ It is adopted only when the points to be surveyed are intervisible & accessible from a single instrument station.

→ orientation is not required.

$\triangle AB \simeq ab$



* We can calculate the Area of abcd.

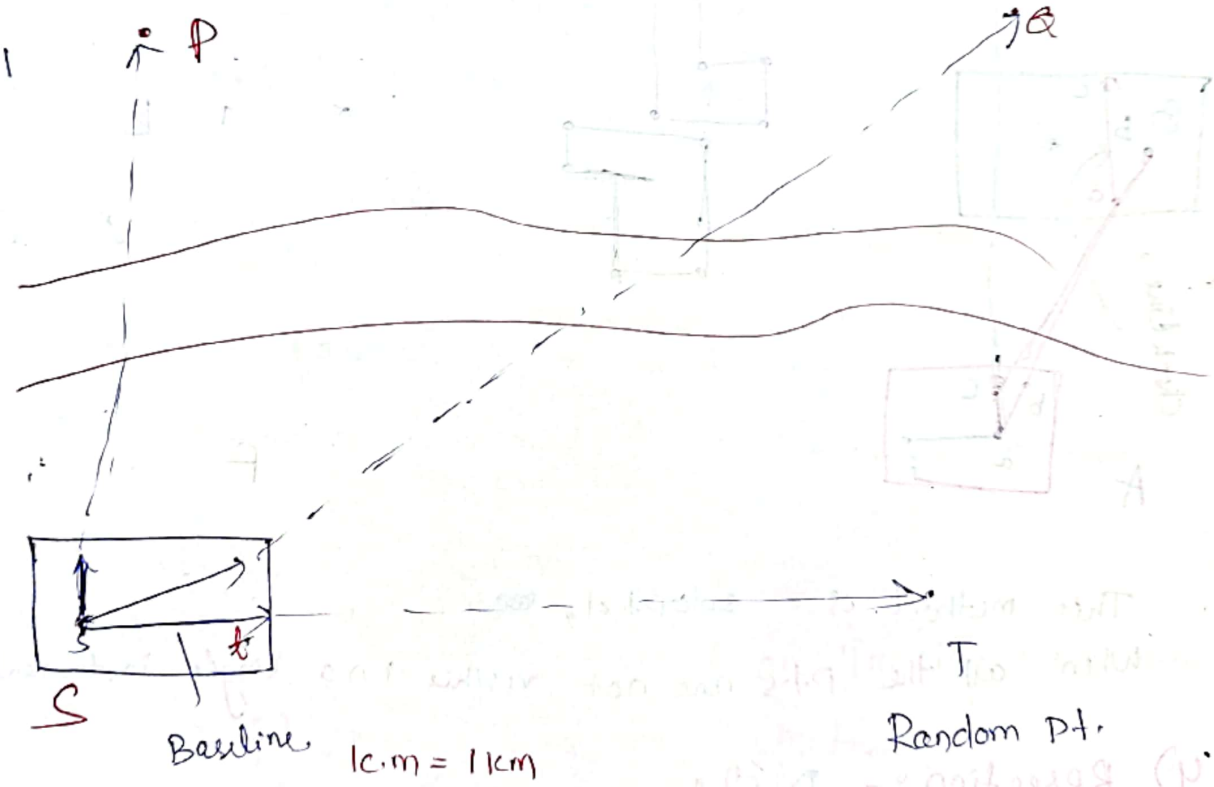
2. Intersection method :-

It is adopted when points are intervisible but are inaccessible.

eg :- Water bodies.

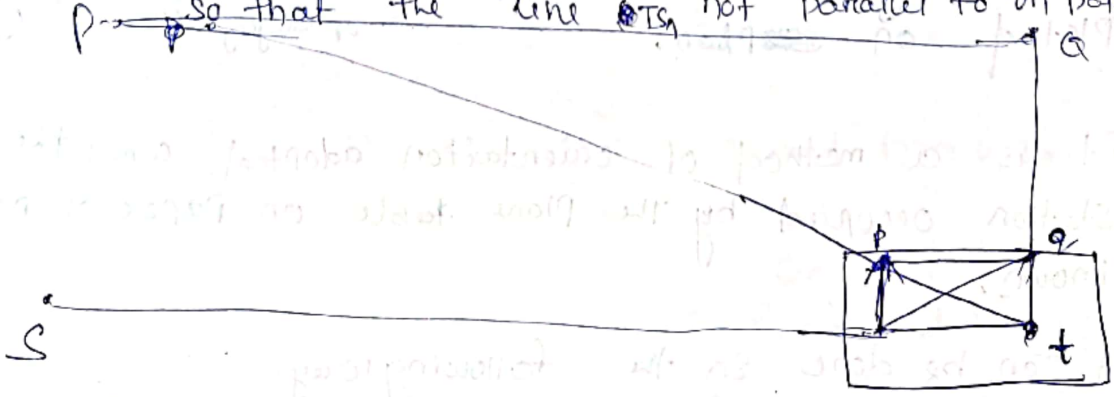
- Here, more than one instrument station is used to solve the problem of inaccessibility.
- Orientation is mandatory.
- It is also known as graphic trangulation.

Step-1



1 c.m = 1 km

Step-2 During shifting of Planetable, it get disturbed, so that the line ST on ground not parallel to on papers.

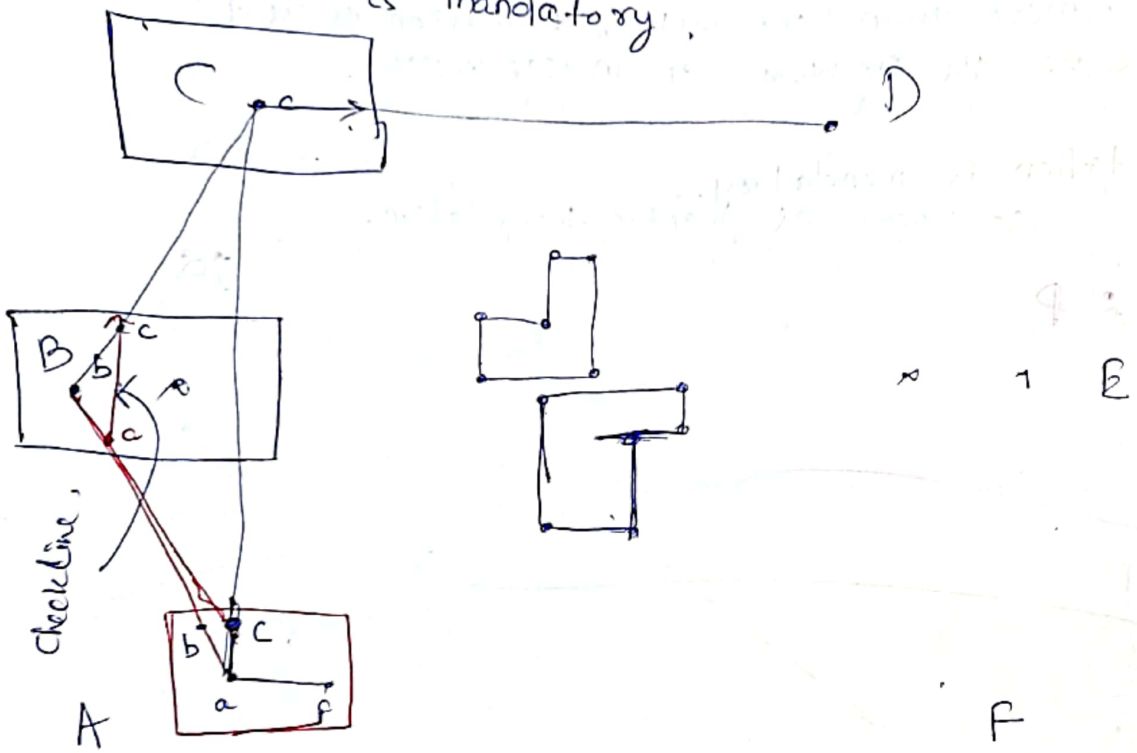


St → Baseline

3) Traversing :-

It is conducted to obtained a traverse on the field, with necessary no. of check lines.

→ Orientation is mandatory.



This method is adopted, when all the Pt·s are not visible in a single instrument station.

4) Resection :- Def^n :-

→ It is the process of obtaining the instrument station occupied by the plane table w.r.t details already plotted on plan.
or Ranging rod

or.

→ It is a method of orientation adopted when the station occupied by the plane table on paper is not known.

→ It can be done in the following ways

- → Resection after orientation by T. compass. (Trough)
- → Resection after orientation by back sighting using alidade.

→ Resection after orientation by 2- Point Problem.
→ Resection after orientation by 3- Point Problem. (more accurate method)
(more no. of details P, Q, R)

Two- Point problem :-
→ more time consuming.
→ more labour required,
→ less accuracy.
→ We need additional instrument station.
→ required two instrument station.
no. of details P, Q..

3- Point problem :-
→ It is less laborious ⇒ less time taking
→ More accurate compared to the 2- Point Problem.
→ It can be solve by
1) Mechanical method or Tracing paper method
2) Graphical or Bessel's Method
3) Trial & error method or Lehmann's Rules,

Radiation method :-

Procedure :-
→ Suppose O is a station on the ground from where the objects A, B, C and D are visible.
→ The plane table is setup over the station O. A drawing sheet is fixed on the table, which is levelled and centred.
A point o (small letter) is selected on the sheet to represent the station O.

Radiation method:-

→ The North line is marked on the right-hand top corner of the sheet with trough compass or circular box compass.

→ With the alidade touching o (small letter) the ranging rods at A, B, C and D are bisected and rays are drawn.

→ The distances PA, PB, PC and PD are measured and plotted to any suitable scale to obtain the points a, b, c, and d, representing the objects A, B, C and D on paper.

fig –

2.) Intersection Method:-

→ Suppose S and T are two stations and P is an object on the far bank of a river.

It is required to fix the position of P on the sheet (p) by intersection of rays drawn from S and T.

→ The table is set up at S. It is levelled and centred so that a point on the sheet is just over the station S. The north line is marked on the right-hand top corner. The table is then clamped.

→ With alidade touching s (small), the object P and the ranging rod at T are bisected, and rays are drawn through the alidade.

→ The distance ST is measured and plotted to any suitable scale to obtained the point t.

→ The table is shifted and centred over T and levelled properly. The alidade is placed along the line 'ts' and orientation is done by backsighting.

→ With the alidade touching t, the object P is bisected and ray is drawn.

→ Suppose this ray intersect the previous ray at a point p. This point p is the required plotted position of P.

Traversing :-

Procedure :-

→ Suppose A, B, C & D are the traverse stations.

→ The table is set up at station A. A suitable point a is selected on the sheet so the whole area may plotted in the sheet. The table is centred, levelled and clamped. The northline is marked on the right hand top corner.

→ With the alidade touching a, ranging rod B is bisected and a ray is drawn. The distance AB is measured and plotted to any suitable scale.

→ The table is shifted and centre over B. It is levelled, oriented by back sighting and clamped. With the alidade touching b, the ranging rod at C is bisected and ray is drawn. Then distance BC is measured.

→ The same procedure is repeated. In this manner all stations of the traverse are connected.

→ If the finishing points doesn't coincide with the starting point there may be some error. This error is adjusted by Bowditch's rule.

Levelling

Levelling :-

→ It is the branch of survey that deals with measurements in the vertical plane.

Object :- Both vertical distance and angles are measured.

Defn :- The object of levelling is to determine the relatives heights of different objects on or below the surface of the earth.

→ To prepare a contour map for fixing sites for reservoirs, dams, barrages etc., To fix the alignment of road, railway, canal etc

→ To find the elevation of a given point.

→ To fix a point at a given elevation.

→ To prepare a layout map for water supply, & drainage scheme.

→ To prepare a longitudinal & c/s^{n} of project to determine the vol^{m} of earth work.

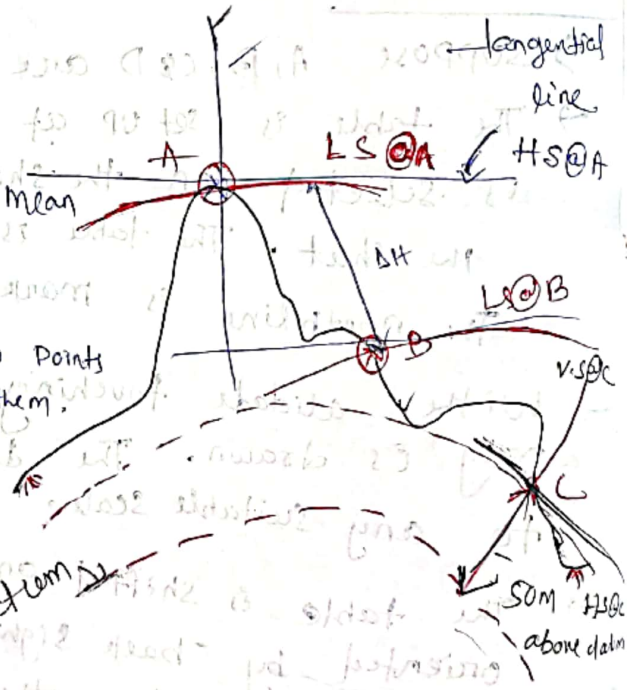
Terminology :-

Level surface :-

→ It is a curved surface parallel to the mean spheroid of the earth.

→ True difference in elevations between two points is always w.r.t the level surfaces through them.

Ex :- Still water surface of a pond, or a lake.



Level line :-

- A line lying on the level surface.
- It is a curved line parallel to the mean spheroid.

Horizontal Surface :-

- A surface tangential to the level surface at a point.

Horizontal line :-

- A line on the horizontal surface.

Vertical Surface :-

- The surface normal or ⊥er to the horizontal surface. at that point.
- Vertical surfaces converge @ the earth center.
- They are not parallel.

Vertical line :-

- A line on the vertical surface.

  Ex :- Direction of gravity., Plumb-line.

Datum :-

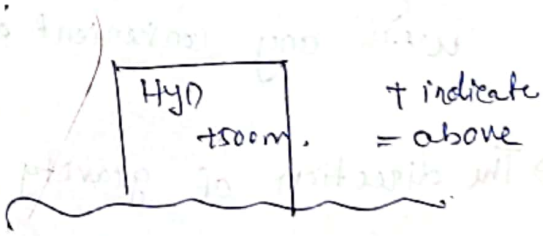
It is a reference surface w.r.t which elevations are measured.

Elevation :-

- Vertical distance measured above or below an assumed datum along the vertical line passing through a points.

Bench mark :-

- A Permanent of known elevation.



1) GTS Bench mark :-

Great trigonometrical survey

→ They were established during the great trignometer survey conducted in the indian Sub-continent.

→ It was geodetic in nature.

∴ GTS Bench mark are highly accurate.

→ They are established at 100 km intervals.

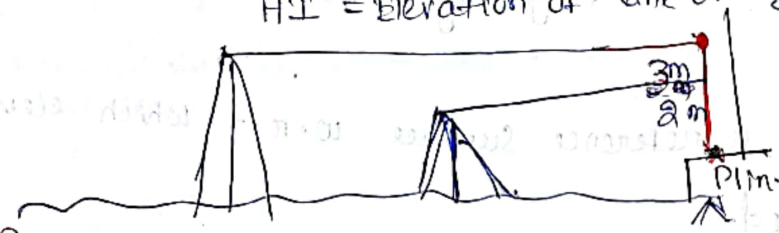
→ They are under the authority of survey of India (SOI),

→ (George everest).

(2) Permanent B.M :- They are established by state agencies like PWDs.

HI = 100m

HI = Elevation of line of sight = 100m.

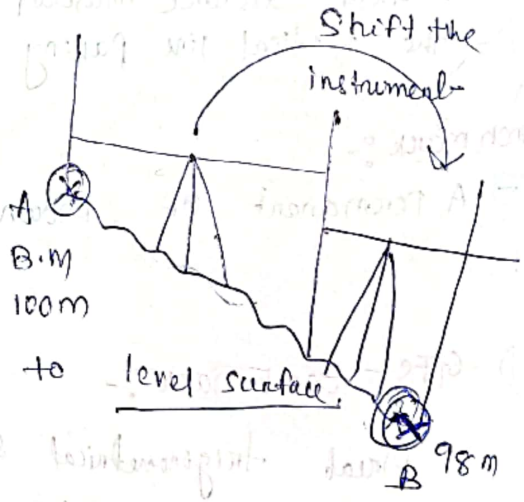


(3) Temporary B.M :-

It is used to transfer the day's elevation so that work can continue the next day onwards.

(4) Arbitrary Benchmark :-

- Any convenient point taken with any convenient elevation.



→ The direction of gravity is normal to level surface.

Methods of levelling :-

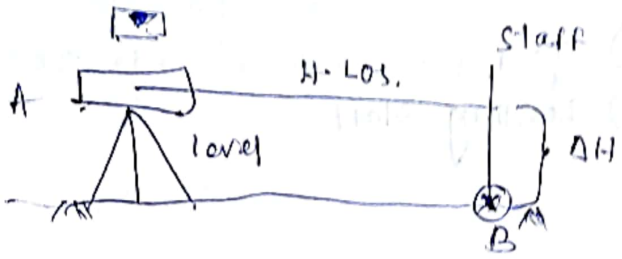
1) Barometeric levelling :-

$$P = \rho g h$$

$$\Delta P \propto \Delta h$$

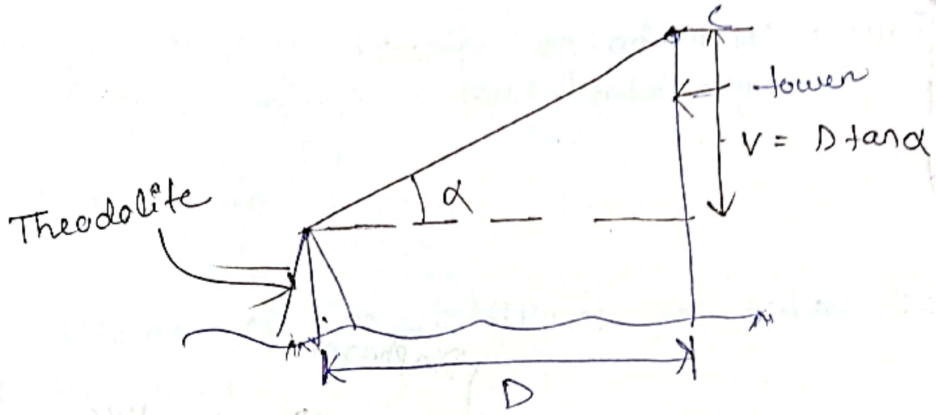
Diff. in barametric pressures in b/w two points is proportional to the differential in elevations between the points.

2) Spirit (or) Direct levelling :-



→ Differences in elevations are calculated w.r.t a horizontal LOS provided by a telescope attached with spirit level & a graduated rod.

3) Indirect or Trigonometric levelling :-



→ Difference in Elevations are calculated indirectly from measured horizontal distance, vertical angles and by using trigonometry

Note :-

* Altimeter :-
  → used in aircrafts to calculate flying altitude above sea-level.

* Hypsometer :-
  → used to measure boiling temp. of a fluid @ a given elevation.

→ $\Delta T \propto \Delta H$ (Hypsometeric levelling)

Instruments used :-

1) Level
2) Levelling staff.

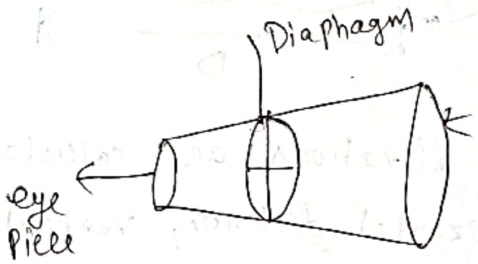
1) Level :-

When in adjustment, the level should always provide a horizontal line of sight.

Main Parts :-

1) Telescope :-
2) Spirit level
3) Levelling head
4) Tripod

Telescope :-



Keplers internal focusing telescope

→ It collects the incident radiation and form a real inverted image.

Diaphragm :-

- The image formed by the objective should lie on the plane of diaphragm for exact observation of staff reading.

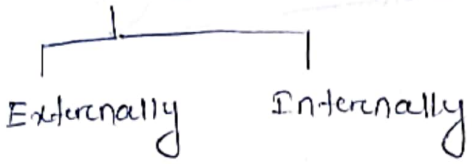
Eye-piece :-

- It enlarges the real image formed by the objective as well as the diaphragm to form a virtual image

Focusing :-

- process of bringing the image formed by the lens to lie exactly on the plane of cross-hair.

Focusing :-

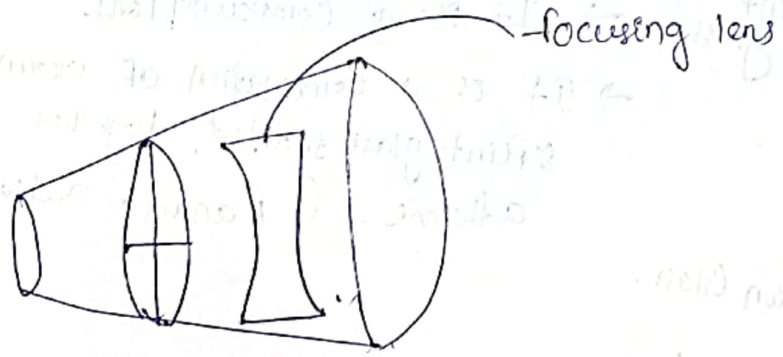


* External focusing telescopes are not preffered as it has more no. of moving parts which causes more wear & tear, therefore reduces the life of the instrument.

* In internal focusing telescope an additional focusing lens. (Double concave) is provided internally.

→ It has more life.

- The presence of an additional lens reduces the brightness of the image.

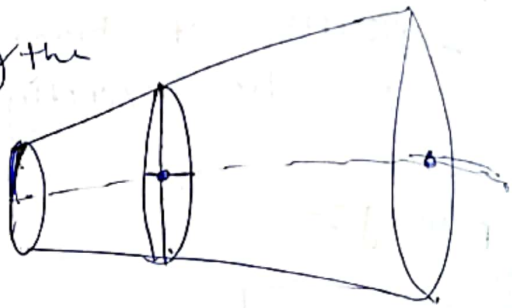


Internal focusing telescope

Note :- Diaphragm is kept closer to the eye piece.

Axis of telescope :-

It is an imaginary line passing through or joining the optical centre of the objectives & optical centre of eye piece.



Line of collimation :-

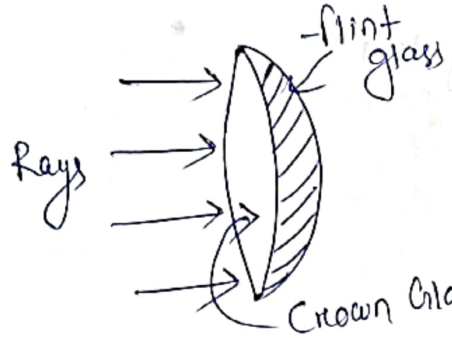
Imaginary line joining the intersection of cross-hairs to the optical centre of the objective & its continuations.

It is known as line of sight.

Line of sight :-

- Imaginary line joining the intersection of cross hairs & the optical centre of objective.

Objective :-

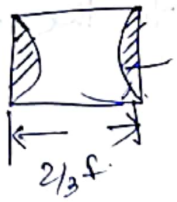


→ It is a compound lens.

→ It is a combination of crown glass & flint glass jointed, together by an adhesive. (Canada Balsam)

Archromatic lens.

Eye Piece :-



Plano-convex lens.

f = focal length of Plano-Convex lens.

Maps

→ knowledge about direction is required for making maps.

→

→ Study of direction.

→ Quadrants and directions.

→ map

→ scale

→ Types of scale

→ R.F

Resection:-

Procedure

⇒ Suppose it is required to establish a station at position P.

* Let us select two points A and B on the ground.
* The distance AB is measured and plotted to any suitable scale.

AB = Baseline.

⇒ The table is set up at A. levelled, centred and oriented by bisecting the rod at B. Table is clamped.

→ With the alidade touching point a, the ranging rod at p is bisected and a ray is drawn.

→ Then a point p_1 is marked on this ray by estimating with eye.

→ The table is shifted and centred in such a way that p_1 is just over p.

It is then oriented by backsighting the ranging rod A.

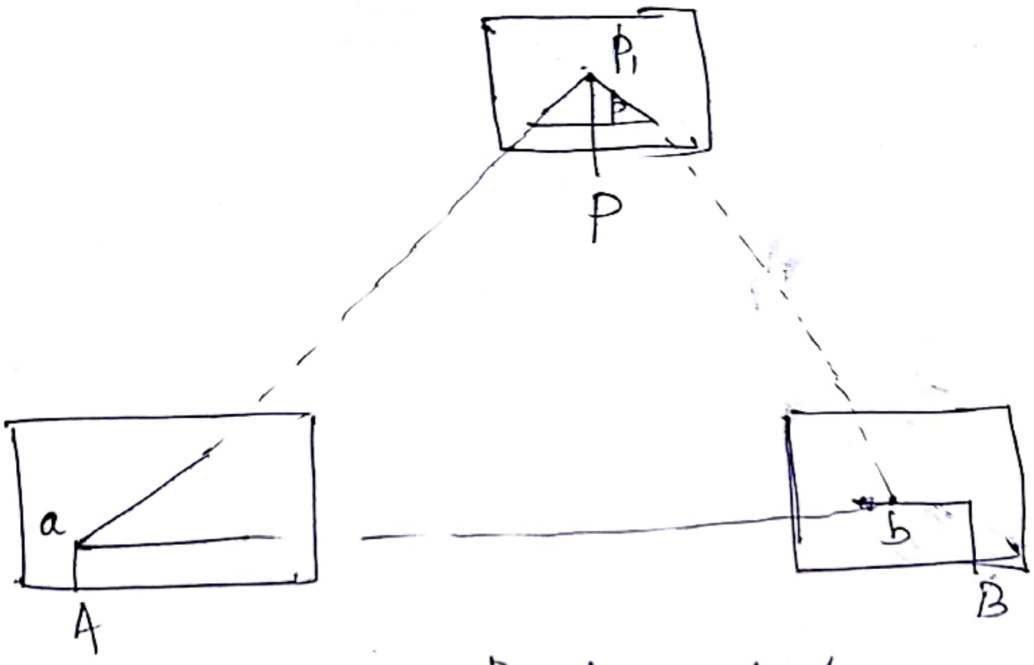
→ Then the table is shifted to B. Levelled and centred.

→ With the alidade touching the point b, the ranging rod at b is bisected & ray is drawn.

→ Suppose this ray intersects the previous ray at point P.

This point represents the position of the station P on the sheet.

→ Then the actual position of the station P is marked on the ground by a fore plumb bob.



Resection method